In no place in the paper is there any reference to a systematic variation in the length of the sun-spot period as claimed in the opening paragraph and also later in Prof. Marvin's discussion. The figure which gives the length of the period for each year is not in any way based on such a supposition and applies equally, whether, as believed by Newcomb, the differences are accidental variations or, as by Lockyer and Clough, they are systematic. The basis of this curve is the observed epochs of maxima and minima, and its accuracy depends solely upon the accuracy with which these have been observed. I refer the reader especially to page 76 of my paper in the February number of the MONTHLY WEATHER REVIEW, where I have discussed the possible inaccuraries.

Prof. Marvin, speaking of the method of tabulation of rainfall data, says: "Exactly the same method has been used by meteorologists almost for centuries." He then proceeds later to criticize the points in which this method differs from the old. To do this he gives a table of months skipped or repeated and shows how much rainfall fell in Washington, D. C., during these months. I would make three replies to this criticism.

(A) The exact form of the method is comparatively new but is already standard. Prof. Schuster, on page 75, *Philosophical Transactions of the Royal Society*, 1906, Volume 206A, makes the first use of it that has come to my notice. In this place he says: "Thus for a period of $7\frac{3}{4}$ years the alternate rows were formed of 15 and 16 figures. This gives 31 intervals of six months for two complete periods, or, on the average, $7\frac{3}{4}$ years. In the last column alternate numbers were missing, and this column was omitted in the calculations of A and B, the number being chosen to correspond to the number of columns retained." As an example of a problem in which numbers were repeated I wish to quote from page 461 of Prof. Turner's paper "On the Fifteen Month Periodicity in Earthquake Phenomena" published in *Monthly Notices* for April, 1919. "The cycle was identified (in the B. A. Report for 1912) as of 104/7 months, which can be approximately dealt with either—

(*a*) by repeating a month at the end of seven complete sets of 15 months ($7\times15=105$), or

(*b*) by collecting sets of 15 months in sevens without repetition and then shifting the initial month one to the right for each set.

The first method (*a*) was adopted in the 1912 report. As a variant the second method was adopted here."

(B) In my paper, totals of rainfall are not the data upon which the arguments were based (although their use would have been legitimate), but ratios between two tables built, each with the same months repeated or averaged, the one using actual the other normal rainfall values. This is clearly stated on page 77 of my paper. The most serious objection that could possibly be raised is that the skipping of months lessens the weight of the argument in direct proportion as the number skipped is to the total number. Thus, if one month in six must be skipped in a certain six years' stretch of data and none in another five years' stretch, the number of months used is the same in each case and the weights of the two stretches are equal. Even this slight objection can not apply if the months are averaged instead of skipped.

(C) The method is legitimate in all cases, no matter how frequently months must be repeated or averaged, but even though one should assume the legitimacy of Prof. Marvin's criticism there would be almost no application to the conclusions of the present paper, since almost his whole argument is based on the large amount of repetition necessary in years earlier than the earliest for which we have state averages.

Prof. Marvin criticizes my application of the method of least squares, as he claims, to rainfall. Regardless of the merits of his objection to its application to rainfall data, I would call attention to the fact that I have not so applied it, but have considered only the differences and similarities of two curves already obtained without its use. The whole argument of the paper is based on the similarity of these curves obtained from different stretches of years.

Long records are certainly needed. It is for lack of long State averages that I included the word possible in the title. I would call attention, however, to the fact that the data used for the average State run through approximately 18 complete cycles—not a short record, as tabulations of physical data usually run.

ERRATA: On pp. 78–79, February REVIEW, legends for Figs. 3, 4, and 5 apply to figures marked 4, 5, and 3, respectively.

551.481 (747)

DATES OF THE OPENING OF ONEIDA LAKE, N. Y., 1869–1921.

By ERNEST S. CLOWES.

[1309 East Adams Street, Syracuse, N. Y., Apr. 30, 1921.]

Oneida Lake is the largest in area in central New York, famous for the beauty and number of its lakes. It is about 25 miles long and averages about 6 miles wide over the greater portion of its length. It is distant 25 miles from Lake Ontario, and its central point is approximately the same distance northeast of the city of Syracuse. Its northernmost point is in latitude 43° 15′.

Although the largest, it is the shallowest of the larger lakes of this region, its average depth being 45 feet and its deepest but little more than 60 feet, as contrasted with the 600-foot depth of Cayuga and Seneca Lakes. For that reason it freezes early in the winter and stays frozen usually until spring is fairly set in, although in this variable climate snowstorms after its opening are not unknown. The country immediately surrounding it is flat and marshy on the south and rolling on the north. No river of any size flows into it, but its outlet at its western end is the Oneida River, a navigable stream used as part of the route of the New York State Barge Canal.

The record of its opening in the spring given here was kept by residents of the village of Constantia, on its northern shore. The ice in the spring breaks up suddenly at the last and in the space of a few hours is blown ashore or carried out down the river, so that the opening of the lake may usually be put down as occurring on a single day. The record follows:

1869	April 21	1896	April 19
1870	April 13	1897	April 2
1871	March 15	1898	March 17
1872	April 22	1899	April 20
1873	April 26	1900	April 18
1874	April 15	1901	April 14
1875	April 17	1902	March 29
1876	April 21	1903	March 21
1877	April 19	1904	April 17
1878	March 15	1905	April 11
1879	April 24	1906	April 6
1880	March 5	1907	April 1
1881	April 23	1908	April 2
1882	March 19–20	1909	April 8
1883	April 20	1910	March 25
1884	April 5	1911	April 15
1885	April 25–26	1912	April 18
1886	April 2	1913	March 22
1887	April 24	1914	April 16
1888	April 18	1915	April 12
1889	April 12	1916	April 14
1890	March 27	1917	April 3
1891	April 13	1918	April 15
1892	April 6	1919	March 21
1893	April 14	1920	April 4
1894	March 21	1921	March 16
1895	April 19		

The average date for the whole period is April 8, but the chief interest lies in the averages for 10-year periods. For convenience these were taken for the 50 years from 1872 to 1921, inclusive, and show for the decades in Table 2. For comparison Table 2 also shows the temperature means of the three months, January, February, and March, at Oswego, N. Y., which were averaged for each year and then 10-year averages worked out. These resulted as follows:

TABLE 2.—*Mean dates of opening and temperatures at Oswego, N. Y.*

Period.	Mean date.	Temperature at Oswego, N. Y.
1872–1881	Apr. 13	27.4
1882–1891	Apr. 10	24.8
1892–1901	Apr. 9	25.0
1902–1911	Apr. 4	26.0
1912–1921	Apr. 5	25.5

The Oswego station is about 30 miles from the lake. With the exception of the first decade the results conform to the theory that the lake is an indicator of the intensity of the winter cold and the earliness of spring combined. One factor which may in part be responsible for discrepancies is that of relative cloudiness and sunshine. Central New York has an excessive amount of cloudiness in winter but the amount, especially in March, is very variable, and it is possible that in some cases where the temperatures were mild the excessive cloudiness prevented the melting of the ice as rapidly as would have occured with normal sunshine. The reverse might also have been the case in some instances, but generally speaking, the melting of the ice seems to be a function of the temperature during the winter and early spring and thus to indicate, in a way, the weather character.

This would seem to indicate that although the lake opened this spring earlier than in any year since 1880, and more than three weeks earlier than the average date, there is a tendency shown in the last 10 years toward a return toward average conditions.

Incidentally, it may be noted that in the record-breaking mild winter of 1889–90 the ice in the lake broke up several times, the last date being March 27. The two years when the lake made its record for late opening, 1873 and 1885, both had hard winters previously, but in 1918 and 1920, when the winters were equally severe, the lake opened little if any later than the average, due to unusual warm periods late in March. The real effect can only be seen by averaging a period at least a decade in length.

The lake records are now kept by Fred Beebe, of Constantia, to whom, and to Miss J. M. Smith, of that village, who has the early records in her possession, the author's thanks are due, as they are also to Mr. Julius G. Linsley, official in charge of the Oswego station of the Weather Bureau, who afforded him ready access to the climatological records of the office.

REGISTRATION OF THE INTENSITY OF SUN AND DIFFUSED SKY RADIATION.[1]

551.590.2 : 551.508.2

By A. ÅNGSTRÖM and C. DORNO.

[Stockholm, Sweden, and Davos, Switzerland, December, 1920.]

[Translated by C. LeRoy Meisinger.]

SYNOPSIS.

The pyranometer of A. Ångström has been combined, at the observatory of Prof. Dorno, at Davos, with a recording device consisting of lamp, galvanometer, and a rotating photographic film, upon which the galvanometer deflection is recorded. In this way records are obtained of the total heat radiation from sun and sky upon a horizontal surface at all times of day, and from this record the daily sums are easily computed. In the present paper the recording method is described, the sources of error are discussed, and finally the results from the records at Davos are presented and compared with results of measurements at Washington and with the records of the brightness previously obtained by Prof. Dorno.

Concerning the instrument.—A. Ångström's pyranometer has been described in an earlier number of the REVIEW.[2] The J. L. Rose Co., of Upsala, has, since that time, furnished a somewhat smaller type of this instrument in a slightly simpler form, without the leveling screw, level, or the screen mechanism for cutting off the sun. The constant of the instrument, furnished by the manufacturers, may be quite accurately checked, by first exposing the strips to the sun and sky, and then to the sky alone. These observations combined with a simultaneously made pyrheliometric determination of the solar radiation intensity, I, and the solar altitude, h, enable one to determine the constant by means of the fundamental formula $R=ci^2$, (where R is the radiation intensity, i the strength of the heating current, and c the constant), and the known relation, $c=\frac{I \sin h}{i^2_1-i^2_2}$, ($i^1$ and i^2 being the two heating currents in the two exposures mentioned above).

Small variations of this constant are to be expected since the absorptive power of the black platinum strip and the reflective power of the magnesium oxide are not absolutely uniform for the entire length of the spectrum of the sun and sky. The constant evaluated in this way for the Davos instrument, 12.93, compares favorably with similar measurements on the larger type of instrument, which, in another manner, was found to be 8.61.[2] The instrument proves to be very reliable and uniform neglecting a few very easily removed deficiencies. Numerous trials have been made at the Davos Observatory and a 10-day comparison was made between the two specimen instruments under very favorable conditions. This comparison was made during the period of November 8 to 17, 1920, the registering instrument proving very practicable. In conjunction with these comparison measurements, records were taken over two November and two December decades. The registration apparatus is described in the January, 1921, *Meteorologische Zeitschrift*. With its application the compensation procedure will naturally be neglected, only the swing of very sensitive galvanometers will register photographically; auxiliary tension and damping resistance will not be considered. Both poles of the thermoelement are grounded, but between one of these and the earth the galvanometer is placed and the necessary resistance introduced to diminish the current. On this arrangement, a galvanometer throw of 1 mm. indicates 0.005 gr. cal./min. cm.^{2}; a very small correction may possibly be applied to this value, while the constant, c, as has already been mentioned, awaits a more absolute determination, because, further, the relations with larger solar altitudes will be more reliable, and because, finally, the quality of the

[1] Published simultaneously in the *Meteorologische Zeitschrift*, Feb., 1921.
[2] Ångström, Anders: A new instrument for measuring sky radiation. MO. WEATHER REV. November, 1919, 47: 795-797.